

Claims

- [c1] 1. A method for stabilizing operating characteristics of a solenoid-operated fluid pressure control valve system in a control valve circuit, the control valve system comprising a solenoid actuator having a stator coil, an adjustable armature responsive to electromagnetic forces and an opposing spring force, and a fluid pressure regulator valve element coupled to the armature, the method comprising:
- applying a base actuating current to the stator coil to effect control of pressure by the control valve assembly;
- establishing an electrical dither frequency for the base actuating current to effect compliance of the control valve assembly as a function of electrical dither frequency as fluid pressure is controlled in response to a pressure command; and
- changing the electrical dither frequency at regulated pressure values within a precalibrated range of regulated pressure values whereby instability of the valve assembly is avoided.
- [c2] 2. The method set forth in claim 1, wherein the electrical dither frequency is established at a value that exceeds a

natural frequency for the solenoid actuator; the step of changing the electrical dither frequency comprising interrupting it when regulated pressure values are within the precalibrated range.

- [c3] 3. The method set forth in claim 1, wherein the controlled pressure is changed by the valve assembly as the base actuating current is varied in accordance with a precalibrated transfer function, and wherein variations in control valve system compliance relative to the transfer function effect a hysteresis whereby a change in controlled pressure due to increases in base actuating current are different than a change in controlled pressure due to decreases in base actuating current, the hysteresis being moderated when regulated pressure values are within the precalibrated range as electrical dither frequency is changed.
- [c4] 4. The method set forth in claim 2, wherein the controlled pressure is changed by the valve assembly as the base actuating current is varied in accordance with a precalibrated transfer function and wherein variations in control valve system compliance relative to transfer function effect a hysteresis whereby a change in controlled pressure due to increases in base actuating current are different than a change in controlled pressure due to decreases in base actuating current, the hystere-

sis being moderated when regulated pressure values are within the precalibrated range as electrical dither frequency is interrupted.

- [c5] 5. The method set forth in claim 1, wherein the electrical dither frequency is established at a value that exceeds a natural frequency for the solenoid actuator; the step of changing the electrical dither frequency comprising adding to the electrical dither frequency a precalibrated frequency value when regulated pressure values are within the precalibrated range.
- [c6] 6. The method set forth in claim 2, wherein the electrical dither frequency is established at a value that exceeds a natural frequency for the solenoid actuator; the step of changing the electrical dither frequency comprising adding to the electrical dither frequency a precalibrated frequency value when regulated pressure values are within the precalibrated range.
- [c7] 7. A control valve system for a geared automatic transmission comprising a variable force solenoid regulator valve for establishing a regulated pressure; an automatic transmission control valve circuit means for effecting control of pressure-operated transmission friction element actuators; the solenoid regulator valve having a solenoid coil, an

adjustable spring-loaded armature within an electro-magnetic flux field for the solenoid coil and a regulating valve element coupled to the armature;

means for applying a solenoid current to the solenoid coil to effect balanced valve element forces on the valve element, the solenoid current having a high frequency dither frequency superimposed on it, thereby reducing variations in solenoid regulator valve system compliance; and

means for changing the dither frequency at precalibrated range of regulated pressure values corresponding to solenoid regulator valve dynamic instability, thereby improving control valve circuit means compliance for regulated pressure relative to solenoid current in accordance with a precalibrated transfer function.

- [c8] 8. The control valve system as set forth in claim 7, wherein the means for changing dither frequency effects an interruption in dither frequency in the precalibrated range of regulated pressure values, thereby avoiding system dynamic instability.
- [c9] 9. The control valve system set forth in claim 7, wherein the means for changing the dither frequency effects a precalibrated increase in dither frequency in the precalibrated range of regulated pressure values, thereby avoiding system dynamic instability.

- [c10] 10. A control valve system for a geared automatic transmission comprising a variable force solenoid regulator valve for establishing a regulated pressure; an automatic transmission control valve circuit means for effecting control of pressure-operated transmission friction element actuators; the solenoid regulator valve having a solenoid coil, an adjustable spring-loaded armature within an electromagnetic flux field for the solenoid coil and a regulating valve element coupled to the armature; a solenoid voltage supply communicating with the solenoid coil for developing solenoid coil current to effect balanced valve element forces; a dither frequency controller communicating with the voltage supply to develop a dither frequency for the solenoid coil current, thereby reducing variations in solenoid regulator valve system compliance; and a dither frequency oscillator communicating with the dither frequency oscillator for changing the dither frequency in a precalibrated range of regulated pressure values corresponding to solenoid regulator valve dynamic instability, thereby improving control valve circuit compliance for regulated pressure relative to solenoid current in accordance with a precalibrated transfer function.

